Mooc on Mobile Robots and Autonomous Vehicles

Christian Laugier, Agostino Martinelli, Dizan Alejandro Vasquez

Mooc Synopsis
Mobile Robots and Autonomous Vehicles

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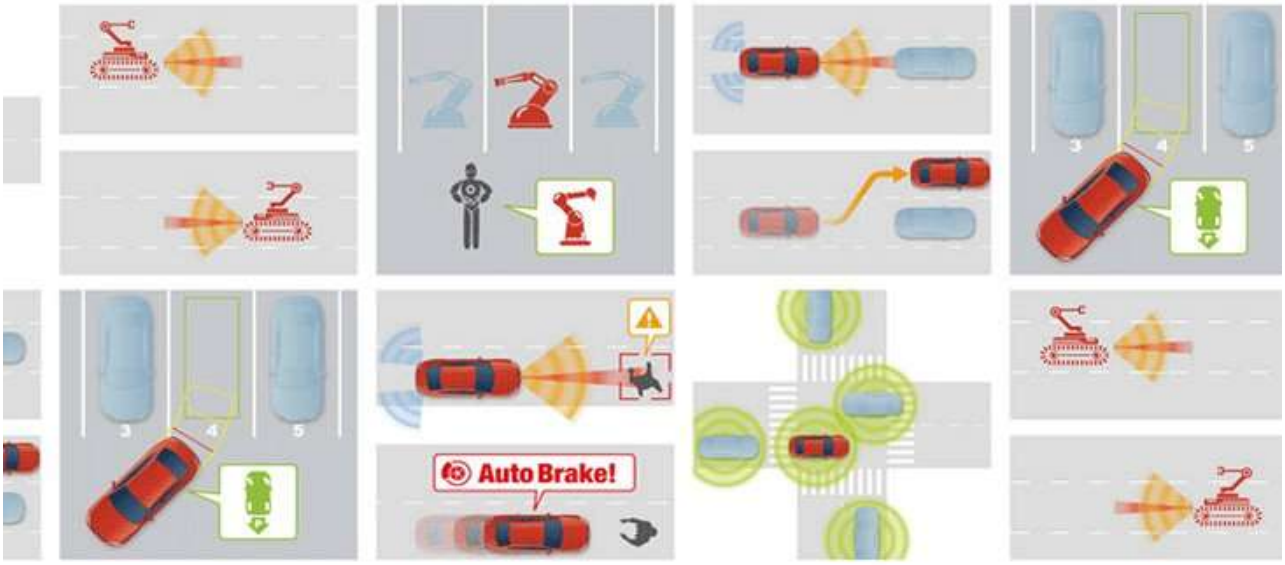

About This Course

Mobile Robots are increasingly working in close interaction with human beings in environments as diverse as homes, hospitals, public spaces, public transportation systems and disaster areas. The situation is similar when it comes to **Autonomous Vehicles**, which are equipped with robot-like capabilities (sensing, decision and control).

Such robots must balance constraints such as **safety, efficiency and autonomy**, while addressing the novel problems of **acceptability** and **human-robot interaction**. Given the high stakes involved, developing these technologies is clearly **a major challenge for both the industry and the human society**.

Course Objective

The objective of this course is to introduce the **key concepts required to program mobile robots and autonomous vehicles**. The course presents both **formal and algorithmic tools**, and for its last week's topics (behavior modeling and learning), it will also provide **realistic examples and programming exercises in Python**.

This course is designed around a **real-time decision architecture using Bayesian approaches**. It covers topics such as:

- **Sensor-based mapping and localization**: presentation of the most popular methods to perform robot localization, mapping and to track mobile objects.
- **Fusing noisy and multi-modal data to improve robustness**: introduction of both traditional fusion methods as well as more recent approaches based on dynamic probabilistic grids.
- **Integrating human knowledge to be used for scene interpretation and decision making**: discussion on how to interpret the dynamic scene, predict its evolution, and evaluate the risk of potential collisions in order to take safe and efficient navigation decisions.

Targeted Audience

The course is primarily intended for **students with an engineering or masters degree**, but any person with **basic familiarity with probabilities, linear algebra and Python** can benefit from it.

The course can also complement the skills of **engineers and researchers** working in the field of mobile robots and autonomous vehicles.

Pre-Requisites

Basic notions of robotics, probabilities, linear algebra and Python (only for week 5).

Course Syllabus

Week 1: OBJECTIVES, CHALLENGES, STATE OF THE ART

Week 2: BAYES & KALMAN FILTERS

Week 3: EXTENDED KALMAN FILTERS

Week 4: PERCEPTION & SITUATION AWARENESS & DECISION MAKING

Week 5: BEHAVIOR MODELING AND LEARNING (with examples and exercises in Python)

Course Teachers

Christian LAUGIER

Dr. Christian Laugier is first class Research Director at Inria (Institut National de Recherche en Informatique et en Automatique – France). He is a member of several international scientific committees and has co-organized numerous IEEE workshops and major conferences in the field of Robotics. He has co-founded 4 start-up companies.

Current research interests: Motion Autonomy, Intelligent Vehicles, Embedded Perception, Decisional Architectures and Bayesian Reasoning.

Agostino MARTINELLI

Agostino Martinelli rereceived a M.Sc. degree in theoretical physics (1994) and a Ph.D. in astrophysics (1999). Since 2006, he is working as a Researcher at Inria, France.

Current research interests: Visual-Inertial Structure from Motion, Nonlinear observability and the Fokker-Plank equation without detailed balance.

Dizan VASQUEZ

Dizan Vasquez received his PhD in Computer Graphics, Computer Vision and Robotics from Institut National Polytechnique – Grenoble, France. He is currently a researcher at Inria, France.

Current research interests: applying machine learning methods to build models of intentional behavior as exhibited by humans, animals, and robots.

Acknowledgment: The course includes some contributions from Stephanie Lefevre, Mathias Perrollaz, Lukas Rummelhard and Amaury Negre.

Organisation and Evaluation

Every week consists in approximately 10 sessions composed of a video lecture, supplementary ressources, associated quiz and applicative exercises.

At the end of the course a statement of completion will be provided for learners having obtained the required score to the quiz and exercises.

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